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Developing Strategies for Adapting Business Processes to Climate Change: Minimizing Risks in the Context of Global Climate Challenges

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Abstract

Extreme weather occurrences are on the rise due to the current worldwide trend of climate change. These modifications have the potential to seriously harm infrastructure, making it impossible for it to function. This article aims to create a plan for lowering risks and adjusting corporate procedures to climate change. Analysis, synthesis, induction, deduction, systemic, legal, systemic-analytical, and systemic-structural procedures were among the techniques used in the study. The study focuses on how firms may adapt to climate change, stressing the value of proactive planning and knowledge of particular climate hazards. Through the utilization of a methodical structure, the approach facilitates the incorporation of current data and adjusts to evolving socioeconomic circumstances. The results show that, especially when it comes to the ambiguity around the scope of climate change and its effects, a strategy for adjusting business operations to climate change and reducing related risks aids in determining the necessary adaptation solutions. Crucially, after putting the suggested steps into place, the adaption method developed in this study may be successfully incorporated into enterprise management procedures, providing qualitative benefits in improving the stability of certain business processes. The study emphasizes that one essential feature of corporate organizations is flexibility. Thus, they must align with their entrepreneurial objectives and have the flexibility to quickly adjust to shifting external circumstances to guarantee their efficient operation and growth. When selecting actions to carry out the change strategy for risk reduction and climate change, it is crucial to incorporate an evaluation process of the resources (finances, commodities) that are accessible as well as the resources (investments, innovations) required for the execution of the adaptation plan.

Keywords

Adaptation strategy; Climate neutral economy; Risk reduction; Green bonds; Environmental projects; Social responsibility of business

Introduction

Climate change is a significant global issue that affects the sustainable functioning of natural and economic spaces. It is important to acknowledge that the level of awareness regarding climate change and its specific adaptation challenges is limited among society and stakeholders. This is due to the uncertainty surrounding the level of temperature rise, the regulatory pathways that will be chosen by the governments, and the potential impact on the financial performance of businesses, economic sectors, and markets. As a result, it is difficult to determine how vulnerable corporate processes are to these developments. To successfully adapt their business operations to future developments, members in the economic segment have developed broad suggestions for adaptation within their industries (Ivanyuta *et al.*, 2020). Thus, extreme weather events can have significant consequences, such as the deterioration of financial assets or deteriorating working conditions for employees, which can negatively affect the economic prosperity of the country. These risks can have either direct or indirect impacts, such as directly affecting the activities of a particular enterprise or causing disruptions in markets and logistics.

Businesses are already feeling the financial and physical effects of climate change. Global operations are already being disrupted, revenues are declining, and expenses are rising due to climate change. These are a few major areas of risk (Nusu, 2023): supply chain disruption; increased expenses; reduced sales; disruption of transportation; food shortages; and regulatory risk. In the future, risk management procedures will become much more difficult if these hazards are not addressed. Simultaneously, climate risk adaptation and preparation can spur business innovation and expansion (see Figure 1). However, businesses must first clearly identify their weaknesses and develop a plan to address them. Therefore, it is becoming more and more important to establish methods for lowering risks and adjusting corporate operations to climate change.

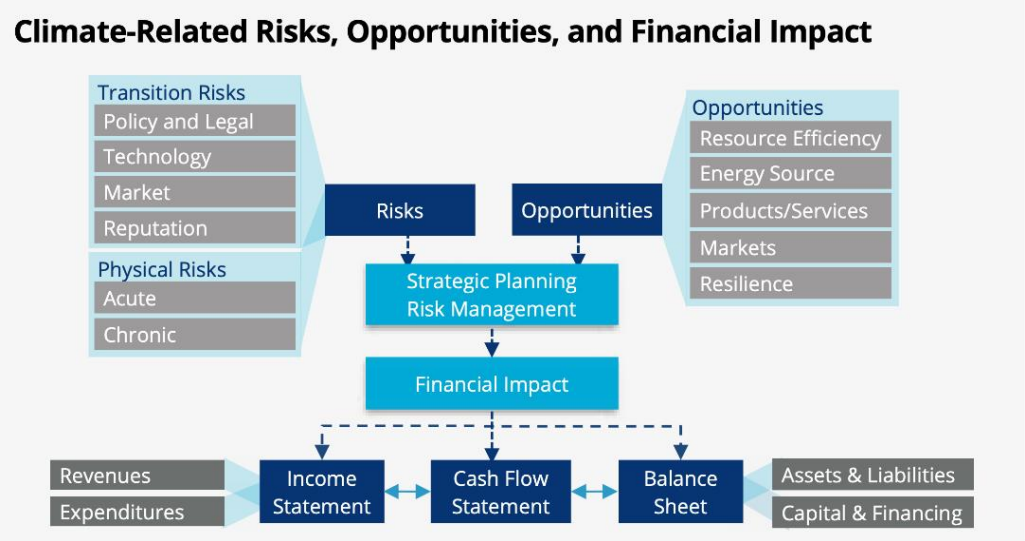

Figure 1: Climate-related risks, opportunities, and financial impact (ASUENE Inc., 2024)

In this context, the article aims to devise tactics for adjusting business processes to changing climate conditions and mitigating associated risks. The research objectives involve defining the essence of the strategy of business process adaptation to climate change and risk reduction. These objectives include the following tasks:

1) to characterise the key positions of the strategy of business processes adaptation to climate change and risk reduction;
2) to conduct a SWOT analysis of the impact of climate change to develop an adaptation strategy;
3) to disclose the stakeholder engagement issues on climate change and risk reduction.

Literature Review

A significant contribution to the study of the development and implementation of enterprise adaptation strategies, particularly in the context of climate change, has been made by many scholars, including Allen and Craig (2016), Alonso-Martinez *et al.* (2021), Altintas (2023), Canevari-Luzardo (2020), Gast *et al.* (2017), Gupta and Dharwal (2022), Karmaoui *et al.* (2023), Kolk (2016), Li *et al.* (2021), Linnenluecke and Griffiths (2013), Pais Seles (2018), Somanathan *et al.* (2021), Vilkaite-Vaitone *et al.* (2019), Yu *et al.*. (2022), Zemigala (2021), as well as Ukrainian scientists Arefieva (2022), Basiuk (2021), Bilykh (2022), Chorna (2022), Gonchar (2023), Holych (2021), Ivaniuta, Yakushenko, Kolomiiets (2022), Izaguirre, Stenek Losada, & Camus (2021), Kostetska (2020), Kruhlova (2017), Kyrylenko (2020), Nechyporenko (2022), Nikolaienko and Manyk (2022), Prots (2018), Tkachenko (2022), Yakovenko (2020), Zhukova (2021), and others.

There is a rising acknowledgement of climate change's potential and problems for businesses (Atteridge *et al.*, 2016; Goldstein *et al.*, 2019). In response to the Task Force for Climate-Related Financial Disclosures (TCFD), businesses and financial institutions have begun to assess the risks and opportunities posed by climate change in their value chains. Similarly, business models that include climate challenges in corporate governance and risk management have emerged (TCFD, 2018). To support this trend, organizations must create analytical techniques that help them better understand climate risks and actions, as well as their business and customer connections. In particular, Holych (2021) studied the issues of enterprise adaptation as a sustainable process which involves adjustment. She stated that it begins with the establishment and ends with the liquidation of a legal entity, aiming to achieve efficiency and stability in enterprise operations through strategic adaptive actions. Her study is grounded in the idea of adaptation, which enables the identification of critical success determinants, the understanding of the process of interaction between a company and its environment, and the determination of strategic growth directions.

According to Yakovenko (2020), strategy is a set of actions that, by using instruments that have been expressly created, guarantee harmony and balance in the way internal operations are carried out, helping the business to accomplish its goals. In the study, the theory of strategic management defines the key principles of strategy formation, the methods of their implementation, and the effectiveness of their implementation to achieve competitive advantage and sustainable development for the enterprise.

Kostetska (2020) defines strategic planning of company operations as a series of steps required to execute adaptation capacities for new social issues and changes in the external environment, as well as to retain market position in competitive settings. The study based on the theory of strategic planning defines the principles of forming strategic goals, analyzing the competitive environment, and choosing optimal development strategies to achieve the successful competitiveness of an enterprise. In her analysis of comprehensive enterprise strategy, Zhukova (2021) highlights the significance of evaluating several choices about all business activities inside the organization and, in turn, creating strategic sets for every phase of company operation. The theory of integrated strategic management defines methods for integrating strategic goals and analysing alternative ways to achieve success. According to Chorna's (2022) research, business processes are specific to a company. The methodical and sequential division of certain operational activities that yield the intended result reveals these processes. Based on the theory of business process management, the paper identifies methods of organizing and optimizing processes to achieve efficiency and effectiveness. Shkurenko and Chorna (2023) concentrate on the instrument for identifying development possibilities and analysing innovations, such as putting measures in place for adaptability to changes. The writers analyse tactical techniques for adapting to ensure a business's long-term existence, drawing on the idea of strategic management.

Prots (2018) highlights the significance of implementing measures to develop individual adaptation potential for each enterprise in the context of climate security issues. It is important to consider the existing and potential resources required for this purpose. Based on the theory of strategic resource management, the author emphasizes the importance of an individual approach to adaptation strategies for each enterprise. Tkachenko *et al.* (2022) characterize the risks associated with climate change, drawing on the theories of risk management and climate adaptation. They point out that while creating suitable adaptation plans, it is important to take into account the "secondary" hazards that these changes create, such as fires, floods, droughts, and other calamities. Nikolaienko *et al.* (2022) outline how climate hazards affect the transportation industry and stress how important it is to any business. They contend that all businesses and infrastructural facilities are at risk from the transportation industry. The authors examine the effects of climate hazards on the transportation industry and consider possible adaptation measures to guarantee the resilience of businesses using the theories of risk management and strategic management.

Romanko (2019) investigated the eco-legal aspects of state policy regarding climate change, using the theories of environmental and legal regulation and strategic management. The author points out that there aren't many fundamental initiatives to help businesses adjust to the new circumstances since the present legal framework to combat these changes isn't being applied locally. The approved Strategy for Environmental Security and Climate Change Adaptation until 2030 (Decree of the Cabinet of Ministers of Ukraine, 2021) lacks the necessary measures to counteract the researched changes. However, the development of adaptation strategies for business processes to climate change and risk reduction has not received adequate attention.

As Zemigala (2021) rightly claims, global warming, greenhouse gases, and climate change emerged as the three most well-explored topic issues in the business context.

However, strategic management and organizational views on the company, namely in the field of business process adaptation and modelling within the efforts of risk reduction, have not been extensively explored in studies about business strategy and climate adaptation.

Methodology

The research is based on the realism paradigm (realism research philosophy implies the idea of reality's independence of the human mind) (Dean *et al.*, 2006). According to this paradigm, reality is "real" but only imperfectly and probabilistically understandable, necessitating triangulation from several sources to fully comprehend it. Thus, the study employed the literature review method (Harris, 2019). Based on a preliminary selection of sources, based on key phrases "climate change", "climate change impact on business", "business' adaptation to climate change", "climate change risk management in business", "business process adaptation to climate change", "sustainable business", and "corporate social responsibility". The study applied elements of the grounded theory toolkit (Urquhart, 2012), namely coding and categorization. The main categories that were revealed are "adaptation", "tailored strategies", "and potential", "green bond market", "sustainability", and "cooperation with stakeholders".

Collection of sources incorporated literature reviews, case studies, theoretical and conceptual investigations and analyses of existing adaptation strategies to ensure a comprehensive understanding of the subject. The array of included sources encompasses a diverse array of sources, including academic journals, monographs, policy documents, reports, case studies, and statistical data websites. The search was made in Scopus, JSTOR, Google Scholar, and ScienceDirect.

The research materials included regulations on implementing public policy to combat climate change, as well as scholarly articles devoted to studying the development of strategies for business processes adapting to changing climate conditions and reducing risks.

The study employed a range of various methods, in particular, analysis and synthesis to determine the essence and features of the object of study, induction and deduction to conclude the features of adaptation strategy in different industries, systemic approach for a comprehensive study of the impact of climate change on the functioning of enterprises, and legal and systemic-analytical method for analysing regulations on the development of strategies for adaptation to climate change and risk reduction.

SWOT analysis was employed to scrutinize the effects of climate change on businesses and formulate tailored adaptation strategies. To identify important shortcomings, take advantage of opportunities, and address innate strengths and weaknesses, the results are carefully evaluated. The inherent unpredictability of climate change estimates, variations in business adaptability, and resource allocation limits for adaption measure implementation are among the acknowledged difficulties. Furthermore, the efficacy of adaptation strategies may be contingent upon contextual factors and industry-specific nuances.

Results

Businesses face the important task of adjusting their strategic plans to adapt to climate change. The problem is complex and does not have a simple solution. To do so, they must demonstrate flexibility and agility in responding to new challenges and actively mobilize their capabilities and resources to meet consumer needs. This is because, to maintain their development and operation, they need to be in line with their entrepreneurial objectives and be able to quickly adjust to shifting external circumstances (Zghurska *et al.*, 2022).

An adaptation strategy should be understood as a set of long-term and short-term measures aimed at increasing the resilience of a business to the consequences of climate change by adapting business processes, resources and strategic planning to new environmental, economic and social conditions (Basok *et al.*, 2021; Sadler *et al.*, 2022; Zghurska *et al.*, 2022). The formation of an adaptation strategy also involves predicting potential threats, implementing innovative technologies to minimize the impact of adverse factors, integrating environmental responsibility into production and management processes, and should also considering the specifics of the industry, regional capabilities and current legislative requirements related to climate change (Kalogiannidis *et al.*, 2024). Serra *et al.* (2022) assert that incorporating various climate change solutions into regional development not only mitigates the negative effects of climate change but also reveals a wealth of chances for regions to promote social welfare, economic growth, and creativity.

An integral element of such a strategy is stakeholder engagement. This term refers to the process of business engagement with the government, investors, consumers, suppliers, civil society organizations, academic institutions, and local communities (Emeka-Okoli *et al.*, 2024). Adebayo *et al.* (2024) note that such engagement helps align interests, set priorities, and jointly address climate change challenges, providing a more comprehensive approach to adaptation and access to additional resources and knowledge.

As Holych (2021) correctly points out, company models are inherently flexible. Businesses may maintain their competitiveness both internally and internationally by using a crucial strategy of adapting to change. The strategy for adapting business processes to climate change should consist of a register of pre-existing solutions related to emerging risks due to climate change. This register should encompass a wide range of potential threats that could destabilize the operations of a specific enterprise. The sources cited (and Dunska, 2022; Maryuk *et al.*, 2021; Bilykh) provide valuable insights into this topic. Moreover, it is important to consider the potential of the business structure and material resources for implementation.

In this context, the term “risk management” should be considered in terms of its effectiveness in monitoring climate change, assessing its potential impact on business activities, creating response plans and implementing measures to reduce the likelihood or consequences of negative events (Ebirim *et al.*, 2024). Thus, risk management involves a systematic process of identifying, analysing, assessing and reducing the impact of risks arising from climate change.

In 2021, Carbon Brief conducted a global study of per-person emissions of hazardous substances. The issue of accounting for the relative size of the population is approached in two different ways, considering, on the one hand, total and, on the other hand, cumulative emissions (Table 1). These approaches produce markedly different results, emphasizing the complexity of interpreting cumulative per-person emissions.

Table 1: Cumulative emissions per population in 2021, country-based

Rank	*Country*	*Cumulative emissions per-person in 2021, tCO_2*	*Rank*	*Country*	*Cumulative per capita emissions*, tCO_2** (year 2021)*
1	Canada	1.751	1	New Zealand	5.764
2	United States	1.547	2	Canada	4.772
3	Estonia	1.394	3	Australia	4.013
4	Australia	1.388	4	United States	3.820
5	Trinidad and Tobago	1.187	5	Argentina	3.382

* Per capita emissions indicate the emissions of an average individual in a country or area. They are determined by dividing total emissions by population.
** Metric tons of CO_2 emissions [*Source:* Evans (2021)]

One conspicuous observation arising from the population analysis is the noticeable omission of several major emitters among the top 5, notably China, India, Brazil, and Indonesia, from the presented data table. Despite their significant contributions to the global cumulative emissions, these nations have substantial populations, consequently mitigating their per capita emissions impact. Remarkably, these four nations collectively represent 42% of the global populace, yet their combined contribution to cumulative emissions amounts to a mere 23% (Evans, 2021).

Digitalization is crucial for accelerating the climate movement. The process of digital transformation involves the transition to digital technologies across all areas of activity and plays a key role in the implementation of strategic measures to combat climate change (Hrustek, 2020). Digitalization has a great potential to achieve climate neutrality aimed at mitigating the effects of climate change through the neutralization of carbon emissions. It is impossible to avoid CO_2 emissions, especially given the size and environmental intensity of industrial complexes. According to Maris and Flouros (2021), carbon emissions in each country depend on the main sectors of the national economy and their specializations. In China, for example, up to 70% of greenhouse gas emissions are caused by the widespread use of solid fuels and energy sources in the manufacturing sector. Similar trends are observed in Ukraine, where this figure is 52%. In addition, in Uzbekistan, Armenia, and Switzerland, up to 33% of CO_2 emissions come from households, both private and commercial, as well as public services. The current circumstances make it possible to achieve climate neutrality by reducing the volume of

environmentally harmful production in the country as well as its gradual transformation (Maksymova and Kurylyak, 2022).

In today's business paradigm, given the drive for sustainable development and the need to adapt to the negative impacts of climate change, the strategy of dual digital and green transition is becoming a priority for businesses. This concept is based on the integration of digital technologies with green initiatives to achieve competitiveness and reduce negative environmental impacts. As an example, the utilization of digital technologies, including a mini-CHP plant equipped with a gas turbine and a heat recovery boiler, as well as the automated control of heating and air conditioning systems, has significantly reduced expenses and enhanced the efficiency of the "Land Rover" SUV production facility (TIC Ukraine, 2022). This approach allows businesses not only to adapt to climate change but also to ensure sustainable and cost-effective development in line with modern environmental requirements and challenges. The dual digital-green transition encompasses several strategies and methods aimed at optimizing and efficiently using resources. The collection, analysis and utilization of substantial quantities of data about climate change and environmental indicators are enabled by digital technologies. This transition presents an opportunity to accurately monitor the environment, anticipate changes, and devise efficient measures to mitigate the adverse effects of climate change on business. This will help reduce CO_2 emissions and conserve energy resources (Dziamulych and Reikin, 2024).

The development of environmentally sustainable initiatives can be ensured through the issuance of green bonds and support for the relevant projects financed by them. The establishment and implementation of a green bond market facilitates the adoption of environmentally friendly technologies and practices, thereby aiding in the adaptation to climate change and the digital-green transition. For example, in Ukraine, the legal framework for the introduction and development of the green bond market was created in 2022 (Verkhovna Rada of Ukraine, 2022) and provides for financing the implementation of environmental projects. Instead, the Paris Agreement, in particular Article 2.1(c), emphasizes the redirection of financial flows to support low-emission and climate-resilient development; and Article 9 calls for the mobilization of financial resources to assist in climate adaptation and mitigation in developing countries. In addition, the development of environmentally sustainable initiatives within the United Nations Sustainable Development Goals (SDGs) including Goal 7 (Affordable and Clean Energy) by promoting renewable energy projects, Goal 9 (Industry, Innovation, and Infrastructure) by promoting sustainable industrialization, and Goal 13 (Climate Action) by financing climate adaptation and mitigation measures.

The goal of the adaptation strategy is formulated based on the desired outcomes of the changes. Specific priorities for implementing concrete measures regarding business processes should be identified, and corresponding parameters (temporal and quantitative) should be established to be implemented in conditions of the most probable risks. The strategic objectives include improving the organizational policy to adapt to climate change at all stages of activity, strengthening institutional capacity through expertise, monitoring, and training to support adaptation activities, and creating conditions for resilience to climate change by strengthening management mechanisms and protecting infrastructure objects as much as possible (Nechiporenko, 2020). It is

important to note that these objectives are aimed at achieving a balanced approach without bias towards any particular perspective. To reduce risks and adapt to climate conditions, it is important to assess available resources such as finances and goods, as well as investments and innovations necessary for implementing the adaptation strategy.

The strategy's key pillars include the following:

1) Risk management. Climate change poses a huge list of risks to business structures, ranging from material to logistical obstacles. This requires each company to assess the risks it may face in the context of global natural changes to help develop adaptation plans that take into account possible threats (Sumets *et al.*, 2022). To reduce risks and adapt to climate conditions, it is important to assess the available resources, such as finance and goods, as well as the investments and innovations needed to implement adaptation strategies. In addition, financial flows can be attracted by using international government flows when implementing climate change initiatives. In this context, the largest absolute and relative year-on-year increase since the Paris Agreement was in public adaptation finance flows to developing countries. This reflects progress toward the Glasgow Climate Pact, which called for affluent countries to at least double climate adaptation funding to developing countries from USD 19 billion from 2019 to 2025. Even attaining the Glasgow Climate Pact objective would only lower the adaptation financing gap by roughly 5%, which is projected to be between USD 187 and 359 billion per year.

2) Sustainability of business structures. Searching for new, even environmentally friendly, models for business activities, abandoning the traditional approach in favour of a "circular" approach will allow to retain resources for the longest time. An example of implementing adaptation strategies is Google, which is implementing innovative climate projects using artificial intelligence. Such projects include optimizing routes in Google Maps to reduce fuel consumption; developing the Flood Hub platform, which provides real-time information about floods and helps prevent their consequences; and creating aircraft inversion trail prediction maps, which help reduce the impact of aviation on the climate. Google also has an ambitious goal of achieving net-zero emissions across its entire value chain by 2030 and moving to a closed-loop economy, using secondary resources as much as possible (Harvard Business School Online, 2024).

3) Adaptation of business organisation. Looking ahead, it is advisable to take measures for future adaptation now, to consider opportunities to change the location of the enterprise, placement and implementation of certain business processes, working methods, and development of new goods or services (Hrinchenko *et al.*, 2023). One such example is New Belgium Brewing Company, a craft beer producer that in 2020 made its Fat Tire Ale the first certified carbon-neutral beer in the United States. The company has implemented several measures to achieve carbon neutrality, including using biogas generated from waste at its water treatment plant to generate electricity; installing solar panels in its production facilities; switching from glass bottles to aluminium cans, which have a lower carbon footprint; and actively participating in projects aimed at restoring ecosystems and supporting renewable energy sources (Harvard Business School Online, 2024).

4) Cooperation with other business structures and stakeholders. It is important to emphasise that no company can cope with climate change alone, and therefore, to successfully overcome these problems, it is necessary to cooperate with these entities (Sytnyk *et al.*, 2022). Focusing on the experience of Kenya, as explored by Gannon *et al.* (2021), where 89% of Kenya is classified as arid or semi-arid, i.e. characterized by climatic variability. In these conditions, projects such as PREPARED and CA4FS, implemented with the support of international initiatives, have demonstrated significant results in the practical application of partnership methods. Within the framework of PREPARED, the focus was on the modernization of weather stations and increasing the capacity of the Kenya Meteorological Department, thereby generating high-quality climate data that were used by insurance companies to develop reliable crop insurance indices. In turn, by involving the private sector through grant mechanisms and cost-sharing systems, the CA4FS project brought together producers, suppliers of resource-saving technologies and buyers of agricultural products. One of the achievements of the project was the creation of conditions for the introduction of climate-smart agricultural technologies. For example, demonstration plots were used to test innovative technologies that were adapted to local conditions, and businesses producing adaptive goods and services received support to enter new markets.

Business adaptation to climate change and business respect for human rights, including environmental rights, are becoming an integral part of modern corporate responsibility. The present strategy for the sustainable development of Ukraine is based on a method of thinking that emphasizes the importance of safeguarding the environment and generating revenue, while simultaneously ensuring that all individuals are provided with the necessities of the present and the future. In general, the concept of sustainable development is based on the principles of responsibility for the future, equality of opportunities, balance between the economy and the environment, and harmonization of population growth with natural resources (UNDP Ukraine, 2017). Economic growth mustn't disrupt the ecosystem, as environmental sustainability holds the key to positive growth. This entails raising awareness of the impact of business on environmental sustainability and the living conditions of society. It is important to consider the human right to life and a healthy environment when developing a socially and environmentally responsible business. Therefore, businesses are actively implementing environmentally sustainable technologies and using renewable energy sources to reduce emissions of harmful substances. At the same time, businesses must adhere to social responsibility and avoid using low-paid labour and harmful materials (Klarin, 2018). This approach ensures not only the success of the company but also the well-being of society as a whole.

The key positions identified should form the basis for developers of adaptation strategies. These strategies will be successful if they are prepared in advance (Figure 2). It is important to note that stakeholders (Wang *et al.*, 2020) must fully understand climate risks specific to their territories and infrastructure, and therefore, know how to reduce the level of impact and uncertainty. Adaptation measures should include the development of a strategy and implementation plan. These should consider temporal and substantive changes in natural phenomena and analyse possible consequences for socio-economic, climate, and technological spheres (Gonchar and Dzhulii, 2023).

It is important to note that the development of adaptation strategies is typically based on cost and outcome analysis in the context of slow climate changes. This is particularly relevant for complex technical systems such as structures and equipment, as well as information systems with short lifecycles. The strategy's components involve a gradual approach, dividing relevant business processes into mini-cycles (Snizhko *et al.*, 2021), which are applied under specific climate risks. However, decision-making may be untimely due to forecast uncertainty regarding the manifestation of specific types of risks (Grosul *et al.*, 2017). By assessing the vulnerability of the enterprise to meteorological phenomena such as floods, hurricane winds, snowstorms, and high environmental temperatures (Arefieva *et al.*, 2022), potential risks for relevant business processes can be identified. This forms the basis for strategy development. The next step involves analysing existing adaptation options and formulating a program to implement necessary measures.

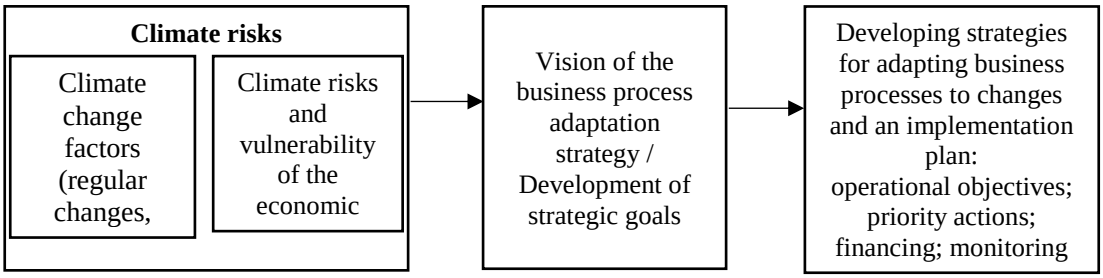
Climate risks
Climate change factors (regular changes,
Climate risks and vulnerability of the economic
Vision of the business process adaptation strategy / Development of strategic goals
Developing strategies for adapting business processes to changes and an implementation plan:
operational objectives;
priority actions;
financing; monitoring

Figure 2: Key elements for developing a climate change adaptation strategy

A basic SWOT analysis template for the impact of climate change on adaptation strategy development (Table 2) is provided. When conducting this analysis, a specific business structure should be developed considering each type of climate impact. The criteria for this analysis include temperature increase, wind speed, and increase or decrease in precipitation. Therefore, it is important to highlight the benefits of climate change impact as a means of gaining a competitive advantage, such as creating new products (Basok *et al.*, 2021). Weaknesses can be addressed by investing in energy-efficient sources or developing more efficient products or services to mitigate the negative effects of climate change. The results of implementing the adaptation strategy for each enterprise are unique and depend on the plan's content. The plan may involve either radical innovative changes in business processes or slow and stable measures (Mironova *et al.*, 2022).

Research on the SWOT analysis of the impact of climate change on the development of an adaptation strategy has shown that in the short term, the changes will be minimal but are expected to increase in the long term (Tymoshenko *et al.*, 2022). Therefore, their impact on business processes may gradually escalate and adapt (Izaguirre *et al.*, 2021). Identified weaknesses indicate a complete reliance on centralized water and electricity systems. This issue could potentially be resolved by implementing autonomous renewable energy power stations and water resource storage systems (Dvigun *et al.*, 2022a). Furthermore, as the earth's temperature increases, the climate becomes drier, which affects the quality of cultivated raw materials, increases pest infestations, and causes various plant diseases to occur more frequently. However, it is important to note that all business process chains are directly dependent on transportation logistics (Chobitok and Shelest, 2021). Therefore, any disruption to transportation logistics could lead to a complete halt in business operations. Implementing measures to protect

transportation infrastructure requires significant investment in the short term (Mahpour, 2021; Trypolska, 2021). However, this investment will help prevent substantial expenses in the future for re-equipping. Simultaneously, it is advisable to evaluate the cost-effectiveness of the implemented adaptation measures about the projected benefits (Masyk *et al.*, 2023).

Table 2: Global E-commerce Growth Forecast

Strengths	*Weaknesses*
1) concentration on the core business, which is the most profitable for the business structure 2) expanding the scope of training 3) the ability to be flexible and respond quickly to market changes and internal factors 4) maximum proximity to the consumer	1) dependence on a centralised power supply 2) use of water as a cooling element 3) quality of raw materials; presence of pests and diseases 4) dependence on water resources 5) dependence on transport logistics
Opportunities	*Threats*
1) uniting enterprises in the same industry to overcome problems 2) state support for business structures through the creation of legal frameworks and financial support	1) risks of changes in electricity supply 2) risks of flooding, flooding of crop fields 3) the risk of reduced water resources; etc.

Source: Attar *et al.* (2022), Santos *et al.* (2023), Shunmathy (2024)

Studies have shown that climate change significantly increases the probability of hazardous natural phenomena, which can cause severe emergencies that endanger human life and health, disrupt transportation logistics, cause material losses, and even environmental damage (Dvigun *et al.*, 2022b). The strategy's adaptation measures should be reviewed and updated, considering forecasts of hazards, vulnerabilities of specific objects, and socio-economic consequences (Figure 3).

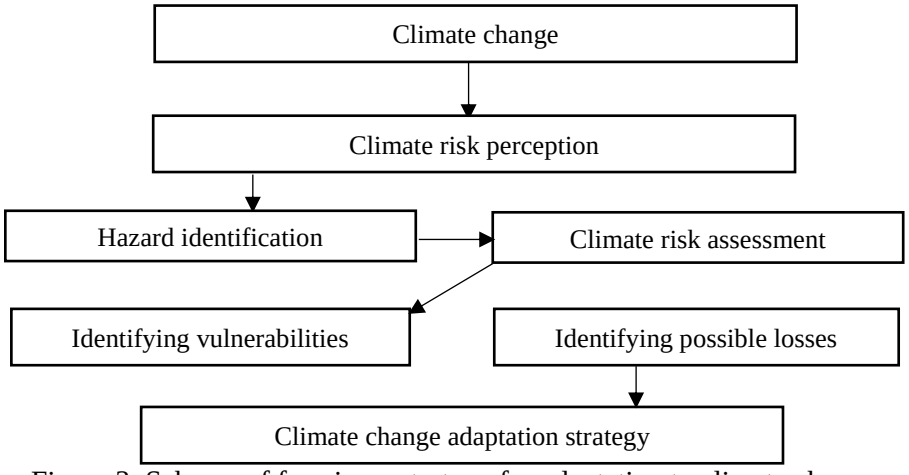

Figure 3: Scheme of forming a strategy for adaptation to climate change

In this context, developing strategies for adapting business processes to climate change and risk reduction requires fostering interaction among stakeholders. These stakeholders include business owners, public authorities, local government bodies, civil society organizations, and other external entities. It is important to ensure that all stakeholders are involved in the process.

Discussion

As the research shows, thus, it can be concluded that climate change acts as a catalyst for developing strategies to adapt business processes and define goals for risk mitigation. The adaptation strategy should include an implementation plan that outlines actions for each type of risk associated with climate change. It is important to note that financial support is a constraining factor in implementing such strategies, which businesses allocate towards addressing threats.

This research outlines a plan of action to protect infrastructure assets during extreme weather conditions. For instance, hurricane winds may cause damage to power lines, leading to power outages. Similarly, transportation routes may be disrupted due to tree collapses and snowstorms (Kyrylenko *et al.*, 2020). Therefore, businesses armed with information about their vulnerabilities can comprehensively assess and identify the most significant threats and circumstances that need to be minimized in the short term for further adaptation activities. Collaborative efforts among business structures and other stakeholders will contribute to mitigating negative impacts and forming the basis for developing proactive strategies to overcome potential threats.

The limitation of our research is the lack of taking into account political factors and SDG agenda at global and national levels, and appropriate further extension of research is needed, with consideration of a broader array of factors, which would make the results more precise. However, our findings still can serve as a benchmark in adapting business processes to climate change.

To prevent maladaptation, it is crucial to conduct an objective assessment of options in both the short and long term. The implementation plan for adapting business processes should be carried out sequentially, reducing the overall risk level to an acceptable level due to climate change with each step. However, the adaptation strategy differs from the traditional approach to executing action plans. It is triggered for implementation over time only when the climate risk reaches a certain threshold (defined for the organization as a red line), which is determined through predictive assessments and meteorological condition monitoring processes (Kryvokhyzha *et al.*, 2023). Once the appropriate measures for adapting to climate change and reducing risks have been selected, they can be implemented according to the execution plan. The evaluation of the effectiveness of these measures influences each subsequent stage, enhancing the quality of the results (Maksymova, 2023; Maksymova *et al.*, 2023).

In summary, the assessment of potential outcomes from implementing the strategy for adapting business processes to climate change and risk reduction involves the following: the strategy is a useful tool for raising awareness among business structures about threats from climate change and the need for management processes of appropriate adaptation

measures. Currently, organizations do not prioritize addressing issues related to meteorological phenomena, as they are focused on achieving entrepreneurial goals. There is no software available that could forecast strategic measures and calculate the costs of adapting businesses to climate change.

With the effects now visible, it is not surprising that some firms have begun to make efforts to adapt to climate change. Many of these activities are reactionary, meaning that businesses are responding to existing climate change consequences or known climate trends. Most clearly, several firms have begun to relocate their headquarters or activities away from potential threats. Other firms are starting to implement or evaluate process modifications in response to the shifting climate. In reaction to growing weather extremes, some farmers have shown an interest in obtaining drought and flood-resistant seeds. Insurance firms are beginning to take initiatives to decrease losses, both by encouraging consumers to mitigate their losses and by modifying underwriting methods (Rivera, 2022).

Successful long-term adaptation, on the other hand, necessitates recognizing and acting on dangers early on, frequently before they materialize, as well as determining acceptable proportional responses. Furthermore, effectively addressing climate change may need a shift in thinking away from dependence on previous patterns and actions and toward an assessment of future climatic changes and their likelihood. As a result, proactive adaption choices that intentionally anticipate future climate change and incorporate them into decision-making will become less clear and more difficult to detect and assess. Screening to detect the possible dangers of near-term and long-term climate change is the first stage in evaluating if a risk assessment is required to suggest additional activities.

The goal of the screening is to establish whether the business is at risk, what parts are in danger, and from whom, and whether a more comprehensive risk assessment is required to determine what if any, measures are required. The screening's purpose is to assign risks to one of three categories: assess immediately, wait and research, or take no action. Screening (as shown in Figure 4) to determine if climate change is a potentially major element in present decision-making consists of multiple steps: detecting sensitivities, identifying the sorts of decisions that are vulnerable to climate change, and assessing the size of the risk.

Moreover, identifying and responding to the effects of climate change can result in significant competitive advantages. Businesses that proactively adjust to changing conditions may assure operational continuity and build a positive reputation with customers and partners. Furthermore, there is a growing tendency in regulatory compliance in which governments establish severe criteria for sustainable activities and carbon reductions. Companies that follow these policies avoid penalties and are typically given incentives.

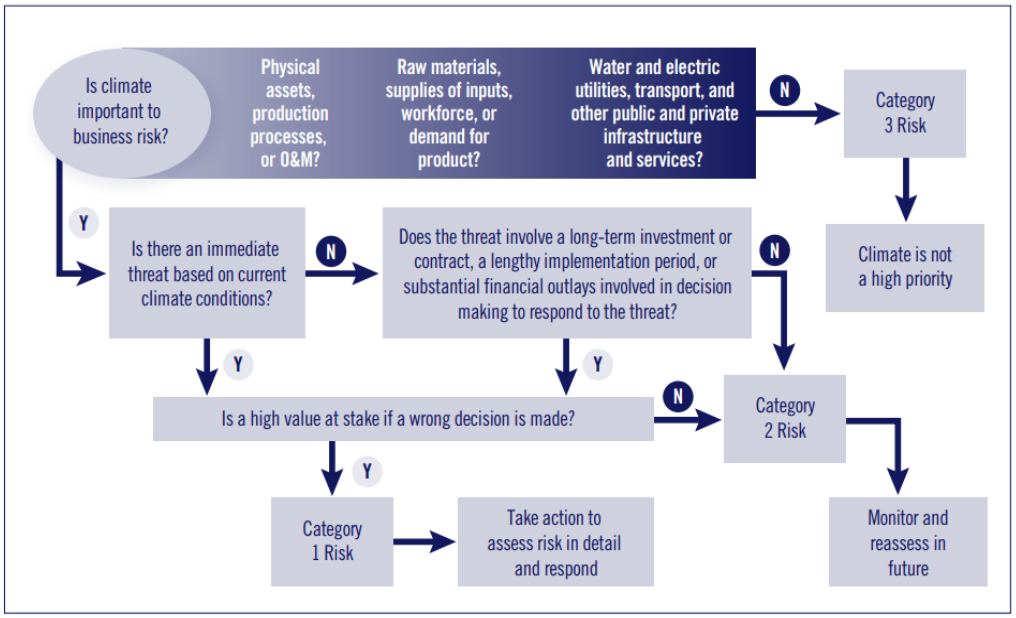
Is climate important to business risk?
Physical assets, production processes, or O&M?
Raw materials, supplies of inputs, workforce, or demand for product?
Water and electric utilities, transport, and other public and private infrastructure and services?
N
Category 3 Risk
Climate is not a high priority
Y
Is there an immediate threat based on current climate conditions?
N
Does the threat involve a long-term investment or contract, a lengthy implementation period, or substantial financial outlays involved in decision making to respond to the threat?
N
Y
Y
Is a high value at stake if a wrong decision is made?
N
Category 2 Risk
Monitor and reassess in future
Y
Category 1 Risk
Take action to assess risk in detail and respond

Figure 4: Screening for climate risks (Rivera, 2022)

Conclusion

Some businesses have begun to assess and potentially respond to the physical effects of climate change, but many still believe that these effects - of temperature rise, hydrology changes, storms, and sea level rise - are either irrelevant to business decisions or too uncertain. Meanwhile, the key to successful adaptation is recognizing the extent of the risk and establishing what steps can and should be taken to address it. It is prudent to consider climate change if it has a major impact on a company's operations, value chain, or overall business environment. As a result, determining whether adaptation is necessary - and what adaptation might accomplish - requires taking a deeper look at the dimensions of potential implications on business.

Therefore, a strategy for adapting business processes to climate change and mitigating risks is developed based on a SWOT analysis. This analysis helps to identify the necessary adaptation solutions, given the uncertainty of the scale of climate change and its consequences. The use of a consistent framework enables the incorporation of updated information and consideration of new socio-economic conditions. The adaptation strategy developed in the study can be integrated into the enterprise management process. This will provide qualitative advantages in the stability of specific business processes after the implementation of proposed measures.

Effective climate adaptation necessitates thorough planning and assessment. To properly adapt to the changing climate, firms must focus on these three key areas:

- Extending risk management frameworks to include climate-related concerns is crucial for business continuity.
- Infrastructure resilience (strengthening of physical assets to withstand increasingly frequent and severe climate catastrophes).

- Understanding technological innovation is crucial for successful climate adaptation
- Regulatory compliance and reporting.
- Community and Ecosystem Resilience (businesses should think about the larger ecological and community implications of their adaption plans).
- Practicing private sector collaboration and policy engagement as crucial tools for shaping effective climate adaptation strategies with governments and international organizations

Thus, our study introduces a novel approach to developing adaptation strategies for businesses facing climate change challenges. It outlines four key pillars: risk management, sustainability, organizational adaptation, and stakeholder cooperation. Practically, it provides actionable insights for businesses to enhance resilience and mitigate environmental impact. Socially, it emphasizes businesses' responsibility in promoting sustainability and respecting human rights. Overall, the study demonstrates the importance of aligning business operations with sustainable development goals and engaging stakeholders to address climate-related risks.

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Authors' Declarations and Essential Ethical Compliances

Authors' Contributions (in accordance with ICMJE criteria for authorship)

Contribution	*Author 1*	*Author 2*	*Author 3*	*Author 4*	*Author 5*
Conceived and designed the research or analysis	Yes	Yes	No	Yes	No
Collected the data	Yes	No	Yes	No	Yes
Contributed to data analysis & interpretation	Yes	Yes	No	Yes	No
Wrote the article/paper	Yes	Yes	Yes	Yes	Yes
Critical revision of the article/paper	No	Yes	No	Yes	No
Editing of the article/paper	Yes	Yes	Yes	Yes	Yes
Supervision	No	Yes	No	Yes	Yes
Project Administration	Yes	No	Yes	No	No
Funding Acquisition	No	No	No	No	No
Overall Contribution Proportion (%)	25	25	20	15	15

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Research involving human bodies or organs or tissues (Helsinki Declaration)
The author(s) solemnly declare(s) that this research has not involved any human subject (body or organs) for experimentation. It was not a clinical research. The contexts of human population/participation were only indirectly covered through literature review. Therefore, an Ethical Clearance (from a Committee or Authority) or ethical obligation of Helsinki Declaration does not apply in cases of this study or written work.

Research involving animals (ARRIVE Checklist)
The author(s) solemnly declare(s) that this research has not involved any animal subject (body or organs) for experimentation. The research was not based on laboratory experiment involving any kind animal. The contexts of animals were only indirectly covered through literature review. Therefore, an Ethical Clearance (from a Committee or Authority) or ethical obligation of ARRIVE does not apply in cases of this study or written work.

Research on Indigenous Peoples and/or Traditional Knowledge
The author(s) solemnly declare(s) that this research has not involved Indigenous Peoples as participants or respondents. The contexts of Indigenous Peoples or Indigenous Knowledge were only indirectly covered through literature review. Therefore, an Ethical Clearance (from a Committee or Authority) or prior informed consent (PIC) of the respondents or Self-Declaration in this regard does not apply in cases of this study or written work.

Research involving Plants
The author(s) solemnly declare(s) that this research has not involved the plants for experiment and field studies. Some contexts of plants are also indirectly covered through literature review. Thus, during this research the author(s) obeyed the principles of

the Convention on Biological Diversity and the Convention on the Trade in Endangered Species of Wild Fauna and Flora.

Research Involving Local Community Participants (Non-Indigenous) or Children
The author(s) solemnly declare(s) that this research has not directly involved any local community participants or respondents belonging to non-Indigenous peoples. Neither this study involved any child in any form directly. The contexts of different humans, people, populations, men/women/children and ethnic people were only indirectly covered through literature review. Therefore, an Ethical Clearance (from a Committee or Authority) or prior informed consent (PIC) of the respondents or Self-Declaration in this regard does not apply in cases of this study or written work.

(Optional) PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses)
The author(s) has/have NOT complied with PRISMA standards. It is not relevant in case of this study or written work.

Competing Interests/Conflict of Interest
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